REMARKS

Claims 9-17 were examined in the Office Action mailed July 28, 2005, with claims 1-8 standing withdrawn pursuant to Election/Restriction Requirement.

Claims 9-12 and 16-17 stand rejected under 35 U.S.C. § 103(a) as unpatentable over U.S. Patent No. 6,139,913 to Van Steenkiste, *et al.* ("Van Steenkiste"), in view of U.S. Patent No. 5,531,590 to Browning ("Browning"). Claims 13-15 stand rejected under § 103(a) as unpatentable over Van Steenkiste and Browning, in further view of U.S. Patent No. 4,004,735 to Zverev, *et al.* ("Zverev").

The Applicants respectfully traverse the pending rejections. The Applicants have amended claim 9 to incorporate the limitations of its dependent claim 10. Claim 9 now recites a cold gas spraying system in which a powder tube is aligned axially and centrically within a Laval nozzle and ends in a divergent section of the nozzle, and the Laval nozzle is "formed by an inner shape of the outer nozzle body together with an outer shape of the powder tube."

The Present Invention: Previously known spraying systems relying on de Laval-type nozzles for gas acceleration, had their particle-injection points located so that they did not disturb the carefully defined geometry of the Laval nozzle (*i.e.*, said geometry providing the desired convergent-divergent flow without flow separations and compression shocks). Specification ¶ [0003]. For example, the Van Steenkiste reference shows a known axial particle injection arrangement, in which the tube carrying the particles to their release point is

located well upstream of the nozzle, where it cannot interfere with the flow converging into the nozzle neck. Van Steenkiste Fig. 2. Alternatively, it was known to provide a duct which introduced particles laterally into the gas flow at the face of the nozzle wall. *See, e.g.*, Browning Fig. 2a (outlet it wall in nozzle divergent section); Ek Fig. 1 (outlet in wall at nozzle neck).

The Applicants discovered that, contrary to the teachings of the prior art to inject particles in a manner which avoided disturbing the Laval nozzle geometry, an axial particle injection tube could be provided in the divergent section of the nozzle while maintaining Laval flow if the nozzle components were redesigned to preserve the desired Laval nozzle flow characteristics, *i.e.*, by shaping the inner surface of the outer portion of the nozzle, and the outer surface of the particle tube to cooperate with one another to provide the desired flow. The Specification explains that this may be accomplished by: altering the outer portion inner wall surface while maintaining a straight particle tube; providing a straight outer portion inner wall and a particle tube whose outer surface expands radially as needed to provide the convergent-divergent flow; or altering both the inner and outer wall shapes to achieve the desired flow. *See, e.g.*, Figs. 2a-2c.

As noted in the present Specification, this discovery allows the present cold spray system to operate substantially more efficiently, as well as being considerably less costly to manufacture and maintain as compared to the prior art. Specification ¶¶ [0008], [0011], [0013] (pressure at particle outlet several MPa lower than at upstream position, reducing particle pumping pressure needs; carrier gas permitted to be at a higher temperature upstream (and therefore

more efficiently provided to the nozzle) because unlike upstream-injected particles, downstream-injected particles are not exposed to higher gas temperatures because the carrier gas is adiabatically cooled as the gas passes through the nozzle neck); *see also* ¶¶ [0004], [0012] (inclusion of a through-neck particle tube permits the outer portion of the nozzle to be manufactured with a substantially larger neck diameter (in order to provide the equivalent area about the particle tube as would have been present in an unobstructed Laval nozzle); this allows the nozzle components to be more conveniently and inexpensively manufactured, as high-precision machining of very fine neck diameters (~1.5 mm) is no longer required).

The Cited References Fail To Teach Or Suggest The Invention: It is asserted in the pending Office Action that Browning's divergent wall-located particle inlet would have made obvious the extension of Van Steenkiste's upstream axial inlet tube into the divergent portion of the nozzle. July 28, 2005 Office Action at 2. The Applicants respectfully traverse this assertion.

Both Browning and Van Steenkiste teach that particle injection apparatus should remain outside of the convergent/neck/divergent regions of a Laval nozzle, thereby avoiding disturbance of the nozzle geometry which is critical to obtaining the smooth acceleration of the gas and particles without flow separations or shock formation. Van Steenkiste focuses solely on defining its nozzle as a conventional, unobstructed Laval nozzle. *See, e.g.*, Van Steenkiste at 3:34-4:17. Browning similarly teaches design of its nozzle in a manner to maintain a conventional Laval configuration. Browning at 3:42-47 ("In the design of the

shock stabilized duct mode unit of the present invention, the area ratio of hole 21 to hole 22 should be the correct ratio for the inlet oxygen pressure ... and provision for shock attachment to the duct wall should be provided").

In view of the failure of either reference to suggest anything with regard to any nozzle arrangement other than a conventional unobstructed convergent/divergent nozzle, the Applicants respectfully submit that there is no suggestion to alter the conventional Laval nozzle geometry of Van Steenkiste to accommodate the present invention's flow-altering particle tube, particularly by altering the nozzle wall and/or the tube outer surface to maintain the desired Laval flow characteristics. Indeed, if the Van Steenkiste tube were to be extended into the divergent portion of the nozzle as asserted in the pending Office Action, the Laval flow in the nozzle would be substantially disrupted by the huge reduction in flow area taken up by the particle tube.

Because Browning does not suggest modification of Van Steenkiste to obtain a system in which the powder tube "ends in a divergent section of the Laval nozzle and is aligned axially and centrically with the outer nozzle body," and "is formed by an inner shape of the outer nozzle body together with an outer shape of the powder tube arranged coaxially in the outer nozzle body and oriented in the spraying direction," claim 9 and its dependent claims 11-17 are patentable over these references under § 103(a). Reconsideration and withdrawal of the pending § 103(a) rejections is respectfully requested.

CONCLUSION

In view of the foregoing amendments and remarks, the Applicants respectfully submit that claims 9 and 11-17 are in allowable form. Early and favorable consideration and issuance of a Notice of Allowance for these claims is respectfully requested.

If there are any questions regarding this amendment or the application in general, a telephone call to the undersigned would be appreciated since this should expedite the prosecution of the application for all concerned.

If necessary to effect a timely response, this paper should be considered as a petition for an Extension of Time sufficient to effect a timely response, and please charge any deficiency in fees or credit any overpayments to Deposit Account No. 05-1323 (Docket #038724.52882US).

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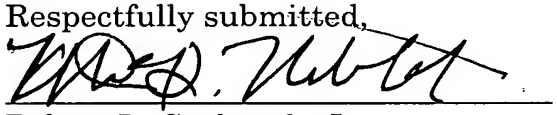
Respectfully submitted,



Robert L. Grabarek, Jr.
Registration No. 40,625
Mark H. Neblett
Registration No. 42,028

CROWELL & MORING LLP
Intellectual Property Group
P.O. Box 14300
Washington, DC 20044-4300
Telephone No.: (202) 624-2500
Facsimile No.: (202) 628-8844